The Supposed "Fascination" of Birds by Snakes.

I have been making further inquiries from my naturalist friends, and find Capt. G. D. H. Carpenter's observation recorded in Nature of November 29 last (p. 244) is confirmed, together with the interpretation there suggested.

Dr. G. A. K. Marshall writes:—"The mobbing of snakes by small birds, and even by fowls, was frequently mentioned to me by residents in South Africa, and my general impression is that I have observed it on various occasions without specially noting it, and I cannot now recall the details of any particular case."

Mr. S. A. Neave, with a wide African experience, felt that the facts recorded by Capt. Carpenter were familiar to him, and associated in his mind "with parties of small finches and weaver birds in open, grassy places," but he was unable to remember any particular instance.

Mr. J. C. Kershaw, for a long time resident in Macao, China, and a traveller in the Malay Archipelago, Australia, and the West Indies, writes:—"I have often seen snakes pursued and annoyed by birds, just as cuckoos and hawks are by small birds, but never saw any sign of 'fascination' by the snake to obtain prey."

Mr. Kershaw has observed the mobbing of all kinds of snakes, and in many countries. "In China *Lanius schach* and *Dryonastes perspicillatus* especially raised an outcry over snakes. I remember one day hearing some shrikes (*L. schach*) making a great hubbub in a tall, thick bush; investigating, I found a snake (some 6 ft. or 8 ft. in length) in the upper part, and threw a clod of turf at it, striking it (by a fluke) about the middle of the body. The shrikes flew off, but the snake remained motionless for nearly half a minute, and then suddenly darted off. The light clod could not have really hurt it."

Mr. J. Williams Hockin, with a very long experience of South India, writes:—"The only case of birds *v.* snake I can remember is seeing a cobra attacking the nest of a ground thrush in a coffee tree at 3 ft. from the ground, and being clamorously assailed by the parents." A little later my friend kindly supplied further details of his observation:—"The cobra attack on ground thrushes (Geocichla, the slate and buff, not Pitta, the ruddy and kingfisher blue one) occurred in the Ellembelary Coffee Estate, three miles from Mepādi Village, in Malabar Wynaad, at an elevation of 3500 ft. So far as I can remember, it was eggs and not young birds the snake was after, but I cannot be sure. It was between 1894 and 1899. As you suppose, I was more humanitarian than scientific in those days, and got off my horse and went into the coffee to drive the snake off. The nest was on the top of a tree about 3 ft. high, the top forming, with those around it, a flat sheet of coffee. The snake was round the stem with its head over the edge of the nest, and the parent birds on each side, shrieking for all they were worth and fluttering round about on top of the boughs. On my approach the snake glided away, and the coffee was too thick for me to get at it. I do not think it took anything. The coffee in Wynaad was topped at 3 ft. or so, and all suckers removed when they appeared, so as to keep an even sheet of cover on the ground."

Not one of the above-named naturalists had seen anything like the traditional "fascination" of birds by snakes. Mr. F. Muir, however, told me that he had seen a bird—I believe in East Africa—sitting on a branch with its bill open and unable to move, while a snake approached and swallowed it. This *may* be an instance of "fascination." Weak-minded birds may sometimes act in this suicidal manner, just as some human beings may be paralysed by fear and unable to defend themselves or to escape from danger. But another interpretation is suggested by the following extremely interesting observation recorded by Dr. G. A. K. Marshall:—"When happening to look over a low stone wall near Estcourt, Natal, in 1897, I chanced to observe a small snake in the very act of striking a frog. After being bitten the latter hopped off at a great pace, and I was rather surprised to see that the snake made no attempt at pursuit, but merely followed in a very leisurely manner. Seeing that the frog had come to a standstill at a considerable distance off, I crept along under the wall, so as not to disturb the snake, and on getting near the frog I looked cautiously over the wall to see the end of the tragedy. The snake was still some way behind, approaching steadily, and on reaching its victim stood watching it for some moments with its head raised, the frog meanwhile sitting trembling in front of it. At last the snake seized its prey, and succeeded in swallowing it after but feeble resistance. It seemed clear that the trembling and inability to escape on the part of the frog were simply due to the action of the poison injected at the snake's first bite. It immediately occurred to me that these observations might supply a simple explanation of many of the stories of 'fascination' by snakes."

Edward B. Poulton.

Oxford, January 2.

THE SCIENTIFIC BASIS OF RATIONING.

An ideal ration is one which provides the adult with sufficient potential energy to meet all the demands made by the organs of his body for transformation into the kinetic form, and enough building material to make good the wear-and-tear of essential cells; a complete ration for children and adolescents must also make provision for the requirements of growth. Three methods of determining the quantities needed to fulfil these conditions are available. The first is to follow as closely as possible the system of an engineer, viz. to study the efficiency of the human machine as a transformer of energy when measurable amounts of work are performed under determinate conditions. The second is to measure the total energy transformed by the body under various conditions, also determinate, although not necessarily permitting of an exact evaluation of the amount of mechanical work done. Lastly, when it is neither possible to measure directly the energy transformed nor to evaluate the work done, the composition of diets consumed by samples of men engaged in different occupations throws light upon the probable needs of different classes.

These methods have been enumerated in a descending order of importance so far as the accuracy of the information which, under favourable conditions, they might yield is concerned; so far as practicability is involved, under normal conditions of life, the order is reversed. We shall refer briefly to the data available under each heading.

(1) The only type of work respecting which numerous and exact measurements both of energy transformed and of external work done are available has been that carried out with a stationary bicycle, the wheels of which are rotated against a known resistance. The best series of experiments is due to Benedict and Cathcart,[1] whose

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[1] "Muscular Work: a Metabolic Study." (Washington, 1913.)

results are concordant with those of Macdonald[2] and others. From these experiments it appears that, for any one person, the relation between H, the total energy transformed (measured in thermal units), and W, the external work done (also measured in thermal units), is adequately expressed by the equation $H = aW + b$, where a is a constant and b a variable parameter, varying with the speed of work performance. In the case of a professional cyclist, upon whom Benedict and Cathcart performed a large number of experiments, a was approximately equal to 3·3, while b increased from 2·4 to 5·2 as the rate at which the pedals were rotated increased from 68–72 to 108–112 revs. per min. When unpractised persons used the ergometer the value of a increased, but the available data were not sufficient to permit of the parameters being determined with any accuracy.

From these results we may infer that (i) the incremental efficiency of muscular work may be as high as 30 per cent. in favourable circumstances, and (ii) the total cost of work performance depends upon its rate. We can scarcely, however, venture to generalise the arithmetical results by using them to calculate the needs of those doing other kinds of work.

(2) This method was largely used by Zuntz and Schumburg[3] in their well-known study of the requirements of marching soldiers, and has also been employed by Amar[4] in investigating the energy transformations of industrial workers. Many physiologists, including Atwater and Benedict, Voit, Rubner, and Tigerstedt, have carefully determined the heat output of persons at rest, obtaining reasonably concordant results, so that the energy transformations of workers can be contrasted with those of sedentary persons.

From Amar's experiments it appears that a metal filer plying his tool at the rate of 70 strokes per minute (a skilled operative, aged thirty-eight years, weighing 74 kilograms) would transform or liberate 3656 Calories daily if he worked at the rate mentioned for eight hours, slept for eight hours, and "rested" the remaining eight hours. The figure just given is reached on the assumption that the heat output during sleep is 1 Calorie per kilogram of body-weight an hour; during non-working but waking hours, 1·25 Calories—assumptions in accord with the means of other experiments. Allowing a margin of 12 per cent. to cover unavoidable waste in the preparation of food and non-assimilation of portions of the ingredients consumed, this daily transformation is covered by a diet having an energy value of 4155 Calories as purchased. Little significance attaches to an isolated series of observations, and it is to be hoped that the method will be more widely employed in that organised physiological research into industrial conditions which is an urgent need of the time.

(3) This process has been widely adopted, the largest individual collections of statistics being (a) those recently compiled and analysed by the Welfare and Health Section of the Ministry of Munitions, and relating to more than 18,000 munition workers[5]; (b) the studies issued from the Nutrition Laboratory of the United States Department of Agriculture, which cover more than 13,000 persons, of whom, however, only a small minority were industrial workers[6]; (c) the Solvay Institute's analysis of the food consumption in more than 1000 Belgian industrial families[7]; (d) English urban working-class and agricultural budgets analysed by the Board of Trade some years ago.[8]

In the following table mean values computed from the above-mentioned material (omitting the American data, which may not be strictly comparable with those describing European conditions) are collected :—

Source of data	No. of observations	Grams of protein daily	Grams of fat daily	Grams of carbohydrate daily	Calories daily
English agricultural families	More than 100	90·9	92·4	570·3	3571
Urban industrial families, earnings 25*s*.–30*s*.	289	91·8	70·6	564·6	3348
Urban industrial families, earnings 30*s*.–35*s*.	416	99·0	82·4	587·6	3581 *
Belgian industrials, moderate and hard work	687	(83·4)	(98·3)	(524·3)	(3495) 3972
Belgian industrials, very hard work	372	(84·3)	(113·1)	(562 8)	(3772) 4286
English munition workers (1917)	18,000	115·7	141·3	408·4	3463

* The average for the whole 1944 families (wages ranging from less than 25*s*. to more than 40*s*.) is :—

Protein	Carbohydrate	Fat	Calories
98·8	593·2	83·7	3615

The figures in this table, excepting those for Belgium, refer to food as purchased. The Belgian investigators have expressed their results in terms of food absorbed by the digestive organs; the deduced averages are accordingly enclosed in brackets, not being directly comparable with the others. The unbracketed figure for Calories is that obtained on the assumption that a discount of 12 per cent. should be allowed between purchased and assimilated values, and is (if the assumption be admitted) comparable with the remaining average energy values.

These statistics must be interpreted with caution. Two assumptions are made in computing nearly all averages of the kind, and a third is often involved also. The assumptions in question are (a) that published analytical results showing the composition of foodstuffs are generally applicable to the qualities used by the persons whose diets are under investigation; (*b*) that in families composed of persons of different sexes and ages the individual distribution of food among the members of the families can be expressed by the age and sex coefficients proposed by Atwater; (*c*) that published coefficients of wastage and proportional absorption are trustworthy. In addition to these special difficulties there are, of course, the usual pitfalls of statistics (errors of sampling, randomness or otherwise of sampling, etc.).

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[2] Proc. Roy. Soc., B, 1917, vol. lxxxix., p. 394.

[3] "Studien zu einer Physiologie des Marsches." (Berlin, 1901.)

[4] "Le moteur humain" (Paris, 1914), pp. 527 *et seq.*

[5] Summarised in Dr. Leonard Hill's "Memorandum on Workers' Food" (Health of Munition Workers Committee, No. 19, Cd. 8798).

[6] Contained in successive Bulletins of the U.S.A. Department of Agriculture.

[7] Slosse and Waxweiler, "Enquête sur le Régime alimentaire de 1065 ouvriers belges." (Brussels, 1910.)

[8] Board of Trade, 1903, Cd. 1761, p. 210; 1913, Cd. 6955, p. 300.

From the evidence furnished by a short series of control experiments carried out by the Belgian inquirers, Slosse and Waxweiler, it seems likely that the American coefficient of reduction for sex, *i.e.* putting the consumption of an adult woman as 80 per cent. of that of an adult man, is not far from the truth; but, on the other hand, the American coefficients of consumption by children may be appreciably too small. The result is that, so far as reduction to "man values" is concerned, the English munition workers' mean is accurate, while the means of the other collections of data (which are reduced from family budgets comprising the nourishment of children as well as that of adults) may over-estimate the *per caput* "man" consumption, perhaps even as much as 20 per cent. Regarding the discount to be allowed for waste in preparation and non-assimilation, much depends upon the constituents of the diet, and the figure of 12 per cent. cannot be regarded as more than a very rough approximation.

Notwithstanding these limitations, the value of the data is considerable, and a study of them might induce some popular journalists and amateur food economists to moderate their strictures upon the extravagance of the English working classes which is alleged to have been fostered by the war-time rise in wages. The data do not suggest that the energy value of the diet consumed by so important a group of operatives as the munition workers is substantially greater than that received by persons of the same social and industrial class before the outbreak of hostilities. The distribution of energy between the three classes of foodstuffs has been different, an inevitable result of the potato famine and the appeals to eat less bread which characterised the period (spring and summer of 1917) during which the data were collected.

The general conclusion to be drawn from the statistics and the relatively few experiments available is that 3500–3800 Calories in food as purchased are by no means an over-estimate of the nutritive requirements of an adult man engaged in moderately strenuous work. Recent work, indeed, confirms the view that Atwater's standard, so far as energy value is involved (3500 Calories), is not an extravagant one.

The *British Medical Journal* in its issue of December 1 directed attention to the fact that the Food Controller's voluntary ration for men on medium work provided about 2100 Calories, leaving a deficit of 1400 Calories from the total of 3500, which the evidence just set out shows to be a minimum requirement of workers in this class. Our contemporary concluded that a weekly consumption of 9½ oz. of fish and a daily consumption of one pint of milk were as much as could be hoped for from these so far unrationed articles, which leaves (cheese being notoriously scarce) a balance of nearly 950 Calories to be obtained from potatoes, involving a daily consumption of more than two pounds. These facts show the urgent necessity of carefully organising the distribution of potatoes within the country and the obligation imposed upon persons living near the centres of supply (for instance, in suburbs with available allotments) to make free use of potatoes, thus helping to increase the quantities of cereals available in the industrial districts to which bulky vegetables are not easily transported. The gravity of the situation imposes a further duty upon the readers of a scientific journal, who must inculcate upon their friends the elementary principles of bioenergetics. That the relation between muscular work and food is as close as that between the mileage of an automobile and its consumption of petrol is a truth still hidden from nine out of ten educated persons; ignorance of the facts has been the parent of many untrue charges.

M. G.

SCIENTIFIC WORK OF THE MEDICAL RESEARCH COMMITTEE.

THE third annual report of the Medical Research Committee, which has recently been published (Cd. 8825: H.M. Stationery Office, price 6*d.* net.), testifies to a very large amount of work of a varied nature. A notable proportion of this has necessarily been devoted to problems arising, directly or indirectly, from the war. But the introductory remarks rightly point out that it is meaningless to try to separate the practical from the scientific aspects of any set of investigations. There are many problems, moreover, which the state of war brings into urgency for solution and, at the same time, offers unique opportunities for inquiry.

Limits of space forbid the reference in detail to all the questions dealt with in this very interesting and important report, and a mere list would be of little value or interest in itself. The report should be read carefully by all who have at heart the health and efficiency, not only of our sailors and soldiers, but also of the nation as a whole. It is proposed here rather to direct attention to a few results of general scientific importance.

It cannot escape notice how prominent have become the methods and results of the physiological laboratory. Two cases may be mentioned in illustration: the regulation of industrial work in relation to fatigue, and the supply of oxygen to men flying at high altitudes. In other instances our ignorance of fundamental physiological processes has been vividly brought home to us. One of these may be referred to in the next place.

Many diseases are caused, as is well known, by the invasion and presence in the blood of minute organisms of animal or plant nature, protozoa or bacteria. This is now, indeed, a matter of common knowledge. For a long time efforts have been